

PATENT
Serial No. 10/757,314
Docket No. JSF01-0002/WJT08-0053

tunable filters tuned by dielectric varactors", issued February 25, 2003 by Zhu et al. This patent is incorporated in by reference. Also, patent application serial no. 09/457,943, entitled, "ELECTRICALLY TUNABLE FILTERS WITH DIELECTRIC VARACTORS" filed December 9, 1999, by Louise C. Sengupta et al. (now continuation application serial number 10/979,001 with the parent application serial number 09/457,943 abandoned) This continuation application serial number 10/979,001 application is incorporated in by reference.--

IN THE CLAIMS

Please amend the claims to read as follows:

1. (Currently Amended) A voltage-controlled tunable multilayer filter comprising:
 - a first resonator on a first layer of dielectric material or low-temperature-co fired-ceramic (LTCC);
 - a second resonator coupled to said first resonator on a second layer of dielectric material or low-temperature-co fired-ceramic (LTCC);
 - a third resonator ~~located on a third layer of dielectric material or low-temperature-co fired-ceramic~~ coupled to said second resonator and cross coupled to said first resonator;
 - an input transmission line connected to said first resonator;
 - an output transmission line connected with said third resonator; and
 - a voltage tunable variable capacitor in at least one of said resonators.

2. (Original) The voltage-controlled tunable multilayer filter of claim 1, further comprising a dc blocking capacitor in at least one of said resonators.
3. (Original) The voltage-controlled tunable multilayer filter of claim 2, further comprising DC biasing circuit associated with said filter.

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4. (Currently Amended) The voltage-controlled tunable multilayer filter of claim 3, wherein said DC biasing circuit lines includes at least one resistor to prevent leakage into said DC biasing circuit lines.

5. (Currently Amended) The voltage-controlled tunable multilayer filter of claim 1, wherein there are a total of nine layers of LTCC ~~tape~~ or dielectric material.

6. (Currently Amended) The voltage-controlled tunable multilayer filter of claim 5, wherein at least two of said nine layerers are used as an ~~the~~ inner ground plane to implement ~~a~~ the stripline structure.

7. (Currently Amended) The voltage-controlled tunable multilayer filter of claim 6, wherein the second layer and the sixth layer ~~layer 2 and layer 6~~ are used as the inner ground plane to implement the stripline structure.

8. (Currently Amended) The voltage-controlled tunable multilayer filter of claim 7, wherein the portion of each combline resonator between said second layer and said sixth layer ~~layer 2 and layer 6~~ is in stripline form and the remainder of the resonators are on the top layer and in microstripline form.

9. (Currently Amended) The voltage-controlled tunable multilayer filter of claim 4, wherein said at least one resistor in the biasing circuit is implemented in the first layer ~~layer 1~~ with resistive paste.

10. (Currently Amended) The voltage-controlled tunable multilayer filter of claim 7, wherein ~~the~~ input output lines are taken to the bottom plane through ~~the~~ apertures in the second layer ~~layer 2~~.

11. (Original) The tunable filter of claim 1, wherein said variable capacitor comprises:

a substrate having a low dielectric constant with planar surfaces;
a tunable dielectric film on said substrate comprising a low loss tunable dielectric material;
a metal electrode with predetermined length, width, and gap distance; and
a low loss isolation material used to isolate an outer bias metallic contact and a metallic electrode on the tunable dielectric.

12. (Currently Amended) The voltage-controlled tunable multilayer filter of claim 1, wherein the a center frequency of the filter is tuned by changing the variable capacitor capacitance by changing a the voltage.

13. (Currently Amended) A method of using voltage to tune a multilayer filter, comprising the steps of:

providing a first resonator on a first layer of dielectric material or low-temperature-co fired-ceramic (LTCC);

providing a second resonator coupled to said first resonator on a second layer of dielectric material or low-temperature-co fired-ceramic;

providing a third resonator ~~located on a third layer of dielectric material or low-temperature-co fired-ceramic~~ coupled to said second resonator and cross coupled to said first resonator;

inputting a transmission line connected to said first resonator;

outputting a transmission line connected with said third resonator; and

varying the capacitance in at least one of said resonators by using a voltage tunable capacitor.

14. (Original) The method of using voltage to tune a multilayer filter of claim 13, further comprising the steps of including a dc blocking capacitor in at least one of said resonators.

15. (Original) The method of using voltage to tune a multilayer filter of claim 14, further comprising biasing said filter with a DC biasing circuit.

16. (Currently Amended) The method of using voltage to tune a multilayer filter of claim 15, wherein said DC biasing circuit lines include at least one resister to prevent leakage into said DC biasing circuit lines.

17. (Original) The method of using voltage to tune a multilayer filter of claim 13, wherein there are a total of nine layers of LTCC tape or dielectric material.

18. (Currently Amended) The method of using voltage to tune a multilayer filter of claim 17, wherein at least two of said nine layerers are used as an the inner ground plane to implement a the stripline structure.

19. (Currently Amended) The method of using voltage to tune a multilayer filter of claim 18, wherein the second layer and the sixth layer layer 2 and layer 6 are used as the inner ground plane to implement the stripline structure.

20. (Currently Amended) The method of using voltage to tune a multilayer filter of claim 19, wherein the portion of each combline resonator between said second layer and sixth layer layer 2 and layer 6 is in stripline form and the remainder of the resonators are on the top layer and in microstripline form.

21. (Currently Amended) The method of using voltage to tune a multilayer filter of claim 16, wherein said at least one resistor in the biasing circuit is implemented in the first layer ~~layer 1~~ with resistive paste.

22. (Currently Amended) The method of using voltage to tune a multilayer filter of claim 19, wherein ~~the~~ input output lines are taken to the bottom plane through ~~the~~ apertures in the second layer ~~layer 2~~.

23. (Original) The method of using voltage to tune a multilayer filter of claim 13, wherein said variable capacitor comprises:

- a substrate having a low dielectric constant with planar surfaces;
- a tunable dielectric film on said substrate comprising a low loss tunable dielectric material;
- a metal electrode with predetermined length, width, and gap distance; and
- a low loss isolation material used to isolate an outer bias metallic contact and a metallic electrode on the tunable dielectric.

24. (Currently Amended) The method of using voltage to tune a multilayer filter of claim 13, wherein a ~~the~~ center frequency of the filter is tuned by changing the variable capacitor capacitance by changing a ~~the~~ voltage.

25. (Currently Amended) A voltage-controlled tunable multilayer filter comprising:

- a first resonator on a first layer of dielectric material or low-temperature-co fired-ceramic (LTCC);
- a second resonator coupled to said first resonator on a second layer of dielectric material or low-temperature-co fired-ceramic;